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SHORT COMMUNICATION

Skeletal Age in Subjects with Mental Retardation

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ABSTRACT

Delayed skeletal maturation has been long accepted as a correlate of mental retardation. Three hundred mentally retarded children were examined for skeletal age and failed to show any overall delay of bone age as compared to chronological age. Further, birth weight was found to be unrelated to bone age maturity. Children with severe levels of retardation displayed significant delay in bone development only when profound physical disability was also present. In eight diagnostic categories of mental retardation, only those with metabolic syndromes showed any significant delay in skeletal system maturation. Conversely, mongoloid children showed a larger-than-chance percentage of advanced bone maturation. Skeletal measures therefore are perhaps more reflective of etiological states than of diagnostic classifications in mental retardation.

THE skeleton is an established register of the development of children. It is also thought to provide a reliable index to a variety of physiopathological states, including mental retardation. Paterson and McCreary[1] and Gothberg and Dayton[2] suggested, for example, that delayed bone maturation is a more or less inevitable correlate of mental retardation. In the following report it is proposed to examine the validity of this widely held opinion, and to attempt to determine whether the most recently established diagnostic divisions of mental retardation can be usefully differentiated on the basis of measures of skeletal age.

PROCEDURE

Three hundred mentally retarded children, referred to the Children's Psychiatric Research Institute, London, Ontario, as outpatients, were examined for relevant physical, neurological, psychometric and laboratory variables. Standard roentgenologic criteria[3] were used to calculate skeletal age by radiographic studies of the skull, hand and wrist. These data resulted in the definition of three bone age groups: (1) those with bone age advanced beyond the chronological age, (2) those with bone age equal to the chronological age, and (3) those with bone age less than the chronological age. The chronological ages of these subjects ranged from 2 weeks to 18 years. Of the 300 children examined, 169 were boys. Based on family income, one-third of the patients were judged to be from the lower socioeconomic level. A wide variety of racial and ethnic origins were represented in the sample.

Bone maturation was evaluated as a possible function of (1) chronological age, (2) birth weight, (3) intelligence, (4) functional status (that is, the extent to which the subject was afflicted physically and mentally), and (5) diagnosis.

RESULTS

Chronological age.—A correlation coefficient of plus .99 was obtained between bone age and chronological age for the 300 mentally retarded children. This coefficient is statistically significant (.001 level) and suggests that for mentally retarded children, as for normal children, bone age is a very close function of chronological age and is not delayed in the mentally retarded to the degree supposed by the previously published literature.

Birth weight.—The recent findings of Knobloch and Pasamanick[4] and of Drillien[5] showed that decreased birth weight is consistent with disabilities in a variety of aspects of growth and development. Consequently, a correlation between birth weight and skeletal age among mentally retarded children might be anticipated. Two hundred and fifty-one patients, whose birth weights were precisely known, were grouped as (a) those having normal birth weights and (b) those whose birth weight was less than 2500 g. (5 lb. 8 oz.). The latter group contained 55 subjects, and both sexes were equally represented within the group. The other 196 children presented clinical data similar to the low birth weight group; and the mean chronological age for the two groups was not significantly different (less than two months' difference).

Statistical analysis of these findings demonstrates no relation between low birth weight and subsequent skeletal growth (chi-square 1.194).

Intelligence.—Two hundred and ninety-three retarded children whose intelligence quotient (I.Q.) could be reliably estimated were grouped according to their degree of mental deficit. Only the category of profound retardation (I.Q. less than 20) showed a significant tendency to delayed skeletal maturation. Since the latter group also manifested serious and multiple physical anomalies, the delayed skeletal maturation is probably not

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meaningfully related to the retardation as such. The 62 patients who displayed profound retardation were compared with 231 patients in the I.Q. 20-plus group by chi-square (15.49 significant at the .001 level).

Functional status.—Considering only those children having profound physical anomalies (congenital, postnatal and prenatal injury, with subsequent paralysis of varying severity) coupled with profound amentia, yielded 55 cases of this type for study. These children were compared, in respect of their bone age, to the residual 242 cases. Chi-square analysis showed that the general functional status was significantly related to delayed bone maturation (9.92 significant at the .01 level).

Diagnostic category.—On the basis of the classifications published in the *American Journal of Mental Deficiency*,[6] 270 patients fell within seven diagnostic categories. The comparative bone development for these groups is listed in Table I. Subjects with disorders of metabolism exhibited the greatest percentage delay in bone maturation, while those with mongolism presented the smallest percentage delay. Indeed, the surprisingly high frequency of advanced bone maturation in mongoloid children is statistically significant when compared to the total of the other diagnostic categories (chi-square 22.33, significant at the .001 level). Since some subdivisions of Table I contain comparatively few cases, no further statistical comparisons are practical. One is impressed, however, by the size of the differences in rate of bone maturation for the various diagnostic sub-sections of mental retardation.

TABLE I.—COMPARATIVE BONE DEVELOPMENT FOR SEVEN ETIOLOGICAL GROUPS OF MENTAL RETARDATION

	Advanced		*Average*		*Delayed*		*Total*
Diagnosis	*N*	%	*N*	%	*N*	%	
Infection	2	11.1	4	22.2	12	66.7	18
Intoxication and kernicterus	1	11.1	2	22.2	6	66.7	9
Trauma and physical agents	9	15.0	17	33.5	34	51.5	60
Disorders of metabolism	3	25.0	0	0	9	75.0	12
Prenatal influence	9	11.1	20	24.5	53	64.5	82
Mongolism	17	46.0	8	21.5	12	32.5	37
Functional reaction	8	15.5	25	48.0	19	36.5	52
Totals	49	18.0	76	28.2	145	53.8	270

CONCLUSIONS

Established opinion notwithstanding, it was not possible in this study to demonstrate a simple or direct relationship between mental retardation and bone development. The most profound levels of mental retardation are only incidentally related to bone age, the more obvious connection being between the concordant physical anomalies and bone age. Birth weight and rate of bone maturation in the mentally retarded seem to be unrelated.

The rate of bone maturation was to some extent a function of the etiology of the retardation under consideration. Further studies of bone development across a wide spectrum of diagnostic categories of mental retardation might conceivably yield useful indices.

Mongoloid children displayed a larger percentage of advanced bone ages compared to subjects with other categories of mental retardation. Conversely, those with the metabolic disorders showed the highest frequency of delayed bone maturation. Overall, however, mentally retarded children can not be characterized effectively by delayed bone maturation.

The problem is an interesting one for ongoing research.

SUMMARY

It has been supposed that delayed bone maturation is typical of mental retardation and that it provides an approximate index of this disorder. Contrary to this supposition, a study of 300 mentally retarded children examined with respect to their skeletal age failed to show any overall delay of skeletal growth. Within eight diagnostic categories separately considered, subjects in the mongol category showed a significant tendency to advanced bone age. Only those with the less common metabolic disorders and the severely retarded children with associated multiple handicaps displayed any significant delay in maturation of the skeletal system.

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